Educational robotics as an Innovative teaching practice using technology: minimization of risks

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Abstract. This research is focused on studying educational robotics, specifically robots which provide functions of educational activity. We have considered the questions of intelligent agents' behavior and have studied their educational opportunities. Educational robotics is a powerful tool of developing person's skills and abilities in various fields of technical creativity and professional activity. The evolutionary development of robotics is connected with development of artificial intelligence, where emotions play a great role in operations. Nowadays the main thing is to form the ability and skills of optimum interaction with social environment when a person, based on gained knowledge, is capable to put goals of the activity in strict accordance with laws and society conditions and using current technology.

1. Introduction

The artificial intelligence does not excel human intelligence. There are many interpretation of the concept "artificial intelligence". According to Allen Newell and Herbert Aleksander Simon, the founders of research in the field of artificial intelligence [1], it is necessary to consider the specific strategy of machine cognitive and peculiar conscious activity. These strategies cause various potential opportunities of a human, considerably strengthening not only his/her physical capacities, but intellectual as well.

David Vernon formulated the concept of computer vision and robot's capacity to self-studying, he practically raised the question about the anthropomorphous robot. In his opinion [2], progress in the sphere of developing and creating robots is too fast, that something that was considered as an artificial intelligence a few years ago is seen as an improved method of research and data processing now.

The aim of the research is to consider the essence and peculiarities of educational robotics as an innovative pedagogical practices using technology, to solve the problem of risks minimization in the usage of robotics in educational environment.

As a result, we have solved such tasks as revealing the subject of educational robotics as a pedagogical technology and forms of its implementation. To achieve the goal and do the tasks we have used cognitive and productive approach in combination with dialectic and competency-based approach. Application of educational robotics within educational process is developed in cognitive and activity plane [3]. Cognitive activity of subjects of educational process is composed of requirements and strivings to acquire knowledge with the assistance of wide range of various sciences, young researchers' (trainees) interest in a problem solving, trainees' personal educational trajectory developing, cross-fertilization between theory and practice in the course of problem solving at the intersection of areas of knowledge. We applied competence-based approach which helped us to

analyze social space of safety formation as a space of organized human activity for eliminating social risks under formation of effective educational process. The competence-based approach has a complex hierarchic-level structure with a plenty of components and is interconnected with system, structural, functional, problem, genetic approaches in studying phenomena and events. This method is focused on a personality and the activity of the personality. Competence-based approach refers to the purpose and the result of education. Competence-based approach holds a special place in training specialists in information and measurement equipment and technology as it integratively opens the questions, requiring the solution, and then solves these problems integrally. Certainly, competence is a social education requirement, but this requirement is rather alienated from a future specialist. The competence is not simple knowledge acquisition; it is relevant competence, skill, knowledge of this competence, a personal quality. Cognitive and productive approach is a method of studying by autonomous system of environment and world, in general, learning by own experience, perceiving consequences of the acts, searching the ways to achieve target tasks and. objectives and adaptation to circumstances which are constantly changed.

2. Educational Robotics as an Innovative Teaching Practice

Educational robotics is a new knowledge acquisition at the intersection of the fields of priority and advanced areas of knowledge in such scientific spheres as mechanics, electronics, automatic equipment, programming, project engineering, circuitry engineering, design engineering. It represents such pedagogical practice using technology when acquisition of knowledge happens in the process of creating a robot. Therefore, educational robotics is focused on two actions: educational and technological.

These two actions are combined and are urgent in the recent period, the period of innovative economy formation and development. We need to emphasize that educational robotics primarily is based on integration of knowledge, received while studying subjects according to educational standards. However, to solve certain specific objectives or problems cognitive achievements of sciences taught variably are integrated [4]. Consequently, we deal with knowledge integration which unites both the first, and the second integrated systems. As result we get the following:

- formation of direct connection between various subjects and scientific branches of knowledge; understanding of education process, meaning of education, necessity to compete in the field of robotics;
- ability to achieve successful results during research and educational process;
- realization of the rivalry of the robotic ideas and decisions in the world.

Nowadays theoretical knowledge is popular in unity with practical knowledge. Owing to the currently central demand of both theoretical and practical the striving to master them more deeply and more widely arises. This can be reached by means of robotics as a technology for mastering a complex of knowledge. Robotics as a pedagogical practices using technology corresponds to the basic Didactic principles of education [5]:

- scientific orientation;
- world outlook orientation;
- problematicity (stating a problem, having several decisions);
- visual aids caused by robotics (drawings, schemes, designs, mechanisms);
- self-actualization of students' own needs for knowledge, self-studying the theory and the transferring theory into a practical product, that is to the robot;
- variability in studying, in choosing complexity of an engineering problem;
- sequence of learning knowledge at robot production;
- solidity and cyclicity of studying;
- stage-by-stage checking robot production;
- deepening knowledge expansion which is necessary for each stage;
- unity of the educational and developing functions of studying.

Modern scientific and technical creativity is expressed through a robotics which is focused on searching, preparing, and implementing younger generation ideas at the interface of researchers on urgent fields of knowledge with vast research prospect in the future. Therefore, robotics represents the unique innovative pedagogical practices using technology sent to search for creative persons. Robotics as pedagogical technology is expressed in educational process in the following forms [6]:

1. Seminars.
2. Symposiums, conferences.
3. Open online courses.
4. School and Conference.
5. Workshops.
6. Forums.
7. Special courses.
8. Specialized laboratories of robotics.
9. Participation in competitions.

The main objective of all forms of expression of robotics as innovative pedagogical practices using technology consists in [7]:

1. students acquaintance to the main principles of robotics, drawing attention to youth scientific and technical creativity;
2. exchange of experience between young researchers;
3. the organizations of communication between subjects of educational process;
4. discussion of the ideas and results of technical realization;
5. knowledge and basic principles of robotics;
6. development of bases of design and designing of robots of various degree of complexity;
7. understanding of an essence of technical creativity;
8. ability to work in team.

Robotics is a form of additional education at schools, lyceums, gymnasiums. In colleges, technical schools, institutes, universities, academies, it keeps the character of additional education. However in educational institutions with robotic profile, robotics is additional education along with the primary educational activity. The teachers, carrying out this form of pedagogical activity, create author's programs on organization and implementation of this innovative pedagogical practices using technology.

At the same time there is a scientific and methodical challenge connected with the problem of concretizing knowledge on robotics course having cross-disciplinary character. As a result, the special course on robotics will allow to implement the ideas of the cross-disciplinary complex, and to promote practical use of theoretical knowledge and enhanced studying of the entering this complex disciplines. Besides, it is possible to enrich robotics course using information from related areas.

Conducting lessons in the international robotics laboratories will be a considerable contribution for development of educational robotics. As a result of involving young forces in such scientific branch as robotics, there will be not only search, but also preparation and support of new highly qualified experienced staff [8]. Owing to successful search, challenging ideas, we can refer to high intelligent potential of the educational system subjects engaged in the educational robotics program. Annually competence content requirements are changed, new ideas appear constantly, and interesting decisions are made. Cognitive character of robotics is developed increasingly. Strengthening the role of educational and pedagogical technology is an important task of educational robotics - it is students' work on cross-disciplinary complex projects in the field of robotics, formation of the up to date intelligent robotics environment which is capable to train experts for developing high technologies.

Competitions, the Olympic Games, conferences having competitive character and characterized by any given degree of competitiveness are of great importance for development of educational robotics. As a rule, competitions are designed for a great pool of participants. The Olympic Games are for intellectual elite. Conferences are for broad interchange of opinions, for scientific and creative intercommunication. In competitions, the Olympic Games, conferences participants are engaged in

self-studying in the field of educational robotics. They can use gained knowledge and modern technologies in practice. In these forms of educational process students gain experience in implementing an innovative project, prepare to work in the hi-tech companies in the sphere of robotics.

Robotic competitions are one of the key insights of educational robotics. They give an opportunity to disclose technical imagination, to exchange the ideas, knowledge, approaches to master knowledge. Cross-disciplinary creative approach in educational robotics is connected with implementation of symbolic method. Educational robotics demands using active and interactive training. In educational process a modeling environment should be created, in which a student works with knowledge and receives an intellectual response of system, and creates the virtual and real world. The symbolic method in educational robotics acts not in opposition to formal logic, but as a connection between real and unreal.

The issue of scientific knowledge is solved not only in harmony of forms and techniques of expressing ideas, but in visual knowledge of the scientific truth as well, in its internal reflection. Scientific ideas have to declare themselves, emotionally influencing student's consciousness. The abstract logical images gaining sensual character turn into concepts of educational robotics. The purpose consists in developing their ability to make sense of life phenomena transformations. In the system of contemporary education there is a tendency to symbolize forms of knowledge acquisition and represent it to integration of scientific, symbolic and mystic knowledge [9].

It is a basis of innovative educational technologies which allow to give knowledge in a creative and figurative form that promotes its stronger training. Symbolic method helps to implement internal human aptitude to studying. It allows to achieve a bright illustration of upbringing and education process. This method influences feelings, rather than exclusively education subject's mind via creating robotic models.

At the carried out study we have succeeded in research objects:

1. The investigation has revealed the subject and the features of educational robotics as an innovative pedagogical practices using technology.
2. We have considered the forms of its implementation.
3. We have developed methodical guidelines on implementing educational robotics as an innovative pedagogical practices using technology.

The innovative educational technology presented by educational robotics is directed to stimulate and develop scientific and technical creativity of youth. The main feature of this technology is to combine competences formulated during the continuous comprehensive educational process of receiving and forming practical skills and theoretical knowledge allowing to realize the creative potential of young people.

Educational robotics is a practical implementation of innovative approach to youth scientific and technical teaching, namely, it is a cross-disciplinary complex of the training, developing, cognitive and methodic actions aimed at the developing young inventors and researchers [10]. The main idea of educational robotics consists in:

1) integration of subjects to create robot and consistently learn all steps of engineering process - from controlled robot to autonomous robot;
2) organizing design and inventive activity;
3) providing life cycle of creative projects – from the idea to an implementation;
4) differentiation of attainment level;
5) providing team work;
6) implementation of professional orientation;
7) using contemporary high technologies.

Use of robotics is connected with risks in educational process, influencing subjects of the educational environment negatively. As a result, it was revealed that robotics and robotic technologies define depth and amplitude of the scope of knowledge. The carried out analysis of the role of social risks in educational system has shown that the process of formation and development of education

depends on the state and the nature of social risks, on the extent of preventive measures with them. The study emphasizes that minimizing risks can be achieved by the tasks limitation and concentration of conditions to use educational robotics, and establish criterion and standards of its application. Orientation of education assessment results is relevant due to the necessity of the theoretical and methodological analysis of training specialist in the robotics and robotic technology. According to the applied method of the analysis and cross-disciplinary approach we conclude that educational process has an integrative nature.

3. The issue of risks and their minimization in using robotics in educational process

Innovative character of educational robotics as pedagogical technology is caused by the combination of the learners' project and practice-oriented activity and use of the modern technologies. Educational robotics is a powerful tool of developing person's skills and abilities in various fields of technical creativity and professional activity.

The key social task for modern society is to form population safety, to establish and develop tolerant relations in society and in education as well. In the modern era the state of scientific and technical assurance of educational process is closely connected with the development of innovative teaching technologies, one of which is robotics in educational process. Applying robotics in educational environment causes risks in implementing interaction of subjects and subjects and objects of educational process as well. To achieve necessary result we need to use methods of risks minimization. Applying these methods it is possible to reach minimization of risks when using robotics in educational process.

The risk inherent in application of such supporting training tool as a robot can influence the result both positively and negatively. It is possible to avoid risk. To achieve this it is enough to apply an avoidance method, that is, to refuse the action connected with risk or to develop the action which is completely excluding risk. However it is not always possible to avoid risks. Therefore, avoidance of one risk can lead to emergence of another. Hence, it is necessary to analyze various ways of minimization [11]. It is possible to reach minimization of risk by limitation of tasks and concentration of conditions for use of educational robotics, and establishment of criterion and standards of its application. The limit of set up problems for particular conditions of studying or research allows to specify the application of a certain type of robotics (specific robots) in the organization of educational process.

The subject of education loses the experience of a harmonious state if a priority and the importance of robotics. Thus, there is a self-loss of "I-ego", loss of understanding the essence of the conscious activity and its difference from robotic, underestimation of the intelligence. There is an emerging of self-estrangement, and the state of admiring robotics, self-opposition, the rise of technologies above a person. From there, the risk of losing yourself as a person, and emergence of dependence on robotics appears. According to the personality's self-loss of its "I-ego" the model of person's social regeneration can be formed. In the beginning a person, being in harmony along, considers him/herself intellectual, creative. But with the development of artificial intelligence, robotics, virtual games, people become the elements of an information field. The first prerequisites of alienated state, alienated thoughts appear. Here we discuss negative results of applying robotics in educational process.

But there are also positive results. Use of robotics promotes knowledge of the world around, transformation of the environment. In this case robotics acts as the tool, a learning tool. For users it is important to master cognitive features of educational robotics, resulting in understanding the importance of intelligence of a person, his/her creativity. Cognitive approach in formation and use of educational robotics allows to increase positivism of using innovative technologies in educational space by means of identifying the mechanism of interaction of the education and robotics subject intelligence as learning tools. The complexity is that understanding of this interaction is possible after understanding the consequences of risk. In modern society the lines of social strain exerting negative impact on education. As a result, risk situations happen [12]. Modern technology equipment, including robotics influences much on risks emergence.

In education system there was always an ideal to educate an all-round and harmoniously developed individual, being not only self-sufficient and having fundamental knowledge, but brought up in the system of moral values. Usefulness and performance indicators [13], that is education commercialization, are the main content of modern educational practice. As a result humanitarian knowledge becomes second-grade, the value of technical and other applied sciences increases. The modern youth is interested in intelligent systems now and gravitates towards developing robots and certain cloning of properties and lines of the person in the robot, believing that it is possible to replace person's monotonous work by robots.

4. Summary

Application of robotics and appropriate technologies facilitates and contributes to the development of interactivity in teaching, developing student's independence and creativity, but at the same time forms egoism and individualism. The egoism and individualism are those features of an individual, which leads to alienation, to professional burning out, emotional failures. The innovation of a robotic technology represents a form of vulnerability of a person against the threats caused by the modernization and development of robotics [14].

The risks caused by an innovation characterize the development stage when old mechanisms lose their efficiency, and new one arises [15]. Unfortunately, the influence of robotics affects often that absolutization of artificial intelligence leads to self-reflection, loss of the "I-ego".

Innovative teaching techniques using robotic technology activate students' attention and perception, make creative atmosphere. The feature of current generation is orientation to the entertaining, visualized teaching techniques specific to contemporary culture [16]. Innovative teaching is risky as it uses untested teaching methods. Teaching by robotic technology is innovative and risky as it is impossible to predict the action of the artificial intelligence. But at the same time use of a robotic technology leads to passive learning material, does not make memory and thoughts to train, as everything is done by a robot. There is time and forces saving, but the psychological indifference is formed.

Competence-based approach is of great importance in training specialists by using robotics and robotic technology. The core of training specialists in the field of robotics is competences, aimed to form system of knowledge, skills and abilities. Nowadays, breakthrough technologies take on great importance. It is necessary to emphasize the role of information and measuring competences. In the course of their mastering people generate knowledge regarding the activity in the field of intelligent systems. The modern robotechnics and robotic technology assume rather good level of computer, information, natural-science, economic and socio-humanistic training of a person. Both in life, at work, and during educational process people deal with the innovative and advanced technologies which very quickly become outdated and make the owner be in a constant stress which can lead to emotional, and even to professional burning out [17].

Communicative practice is a part of business communication. For communicative practice in the system of robotics it is necessary to have skills and knowledge in the information and measuring techniques and technologies, knowledge of using them [18]. In the implementation of communicative practice by means of robotics it is necessary to be professional in using methods of acting in various situations. Robotic technology is favorable for development of individual approaches to training future specialists. Owing to cognitive features this is a fundamental condition of a competence-based approach [19,20].

Robotic technologies provide the efficiency of technical means and their profitability via optimum distribution of information and actions [21]. The robotic technologies are adaptive. When they were introduced into educational process, then methods, technologies and a methodological support of educational process using robotic technology and robotics started regulating.

Global penetration of robot technologies into education considerably raised technical and methodical capabilities, it promoted enhancement of didactics. New quite efficient forms of education appear with the development of robotics.

Educational process using robotics and robotic technology keeps continuity of traditional education system, contributes to the development of innovative teaching model. The birth of robotics and robotic technology, despite the risks, makes changes in education system. The problem of minimizing risks in the use of a robot technology in educational process requires the solution owing to the existing education process modernization.

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